Fig.1A

(1)

(2)

(3)

BACKWARD DIRECTION ←

Fig.1B

(1)

(2)

(3)

→ FORWARD DIRECTION

Fig.1C

VOLTAGE

TIME

Fig.2A

7

1

9

5

3   4

BACKWARD DIRECTION   FORWARD DIRECTION

Fig.2B

MOTION OF DRIVE ROD	ADVANTAGEOUS EFFECT
8a	MOVING BODY MOVES FORWARD
8b	MOVING BODY MOVES BACKWARD
8c	FRICTION REDUCES

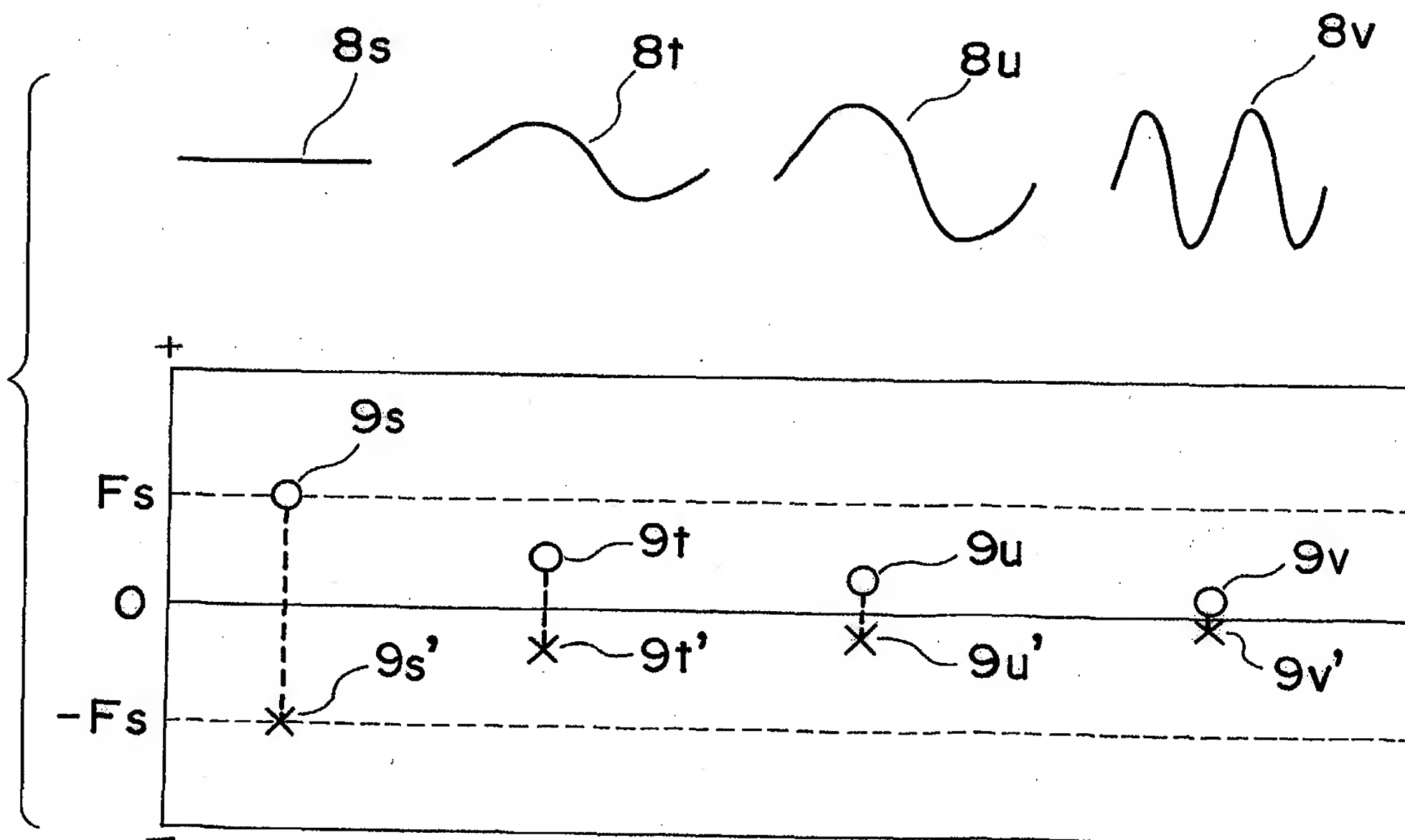# Fig.3A

BACKWARD
DIRECTION

FORWARD
DIRECTION

Fig.3B

Fig.4A

BACKWARD DIRECTION ← 9 → FORWARD DIRECTION

Fig.4B

Fig.5

Fig.6

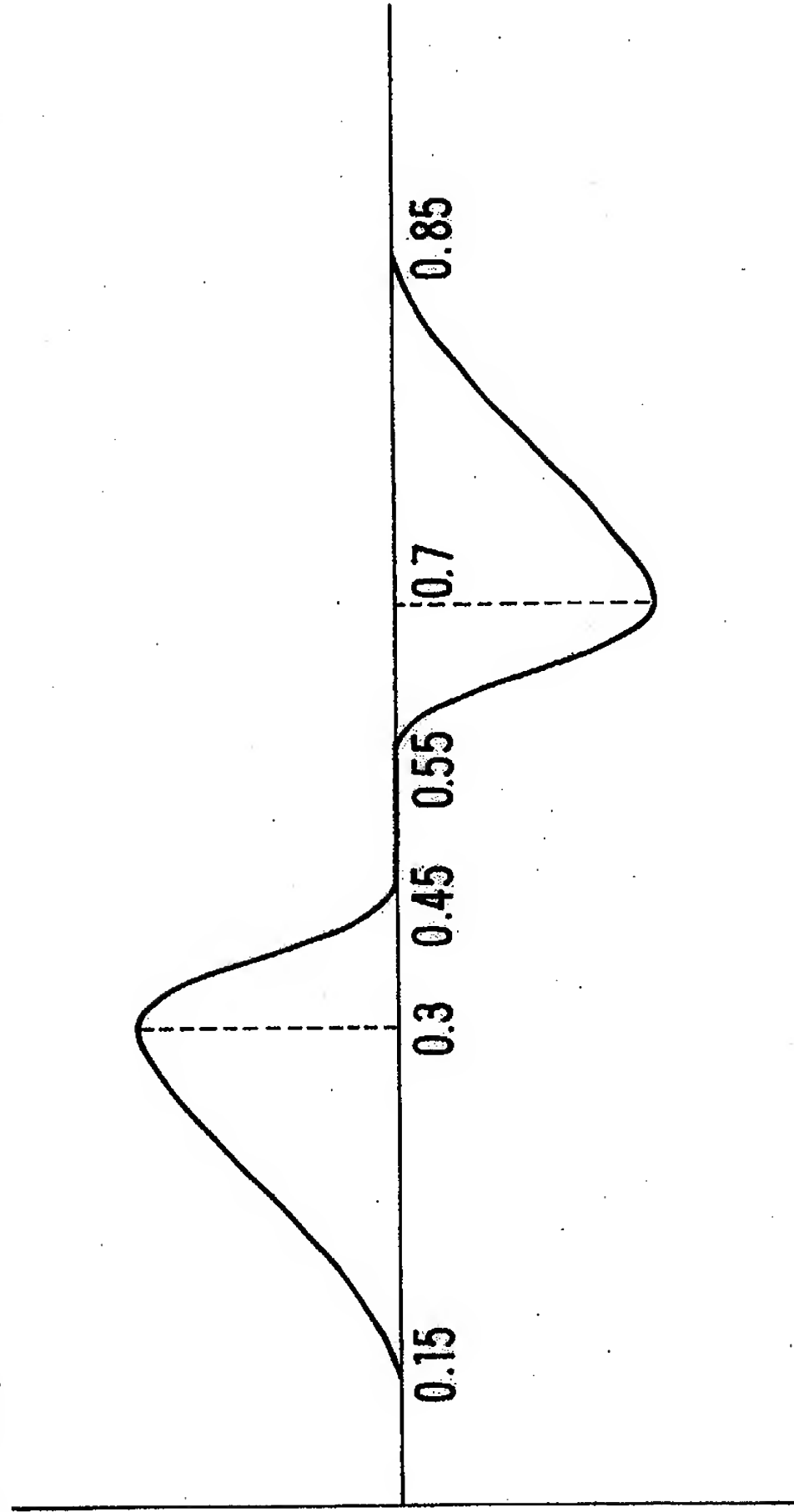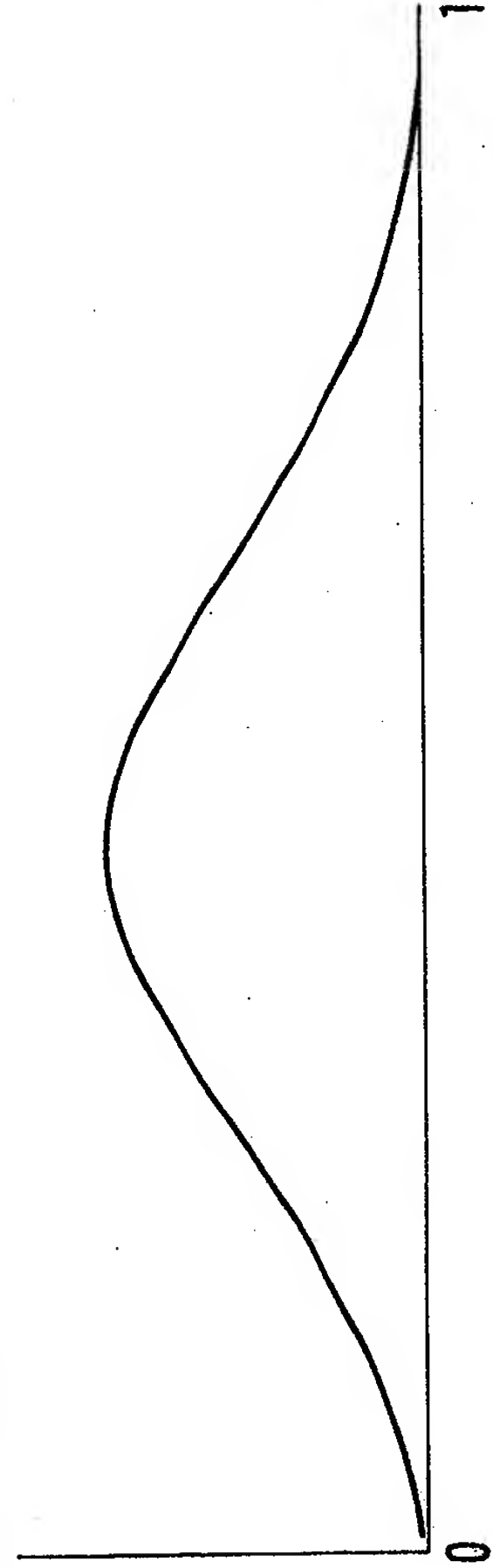| MOTION OF DRIVE ROD	fd≪fs	0.5fs<fd<fs	
		OPTIMAL WAVEFORM	APPROXIMATE WAVEFORM
10	10a	10b	10c
12	12a	12b	12c
14	14a	14b	14c
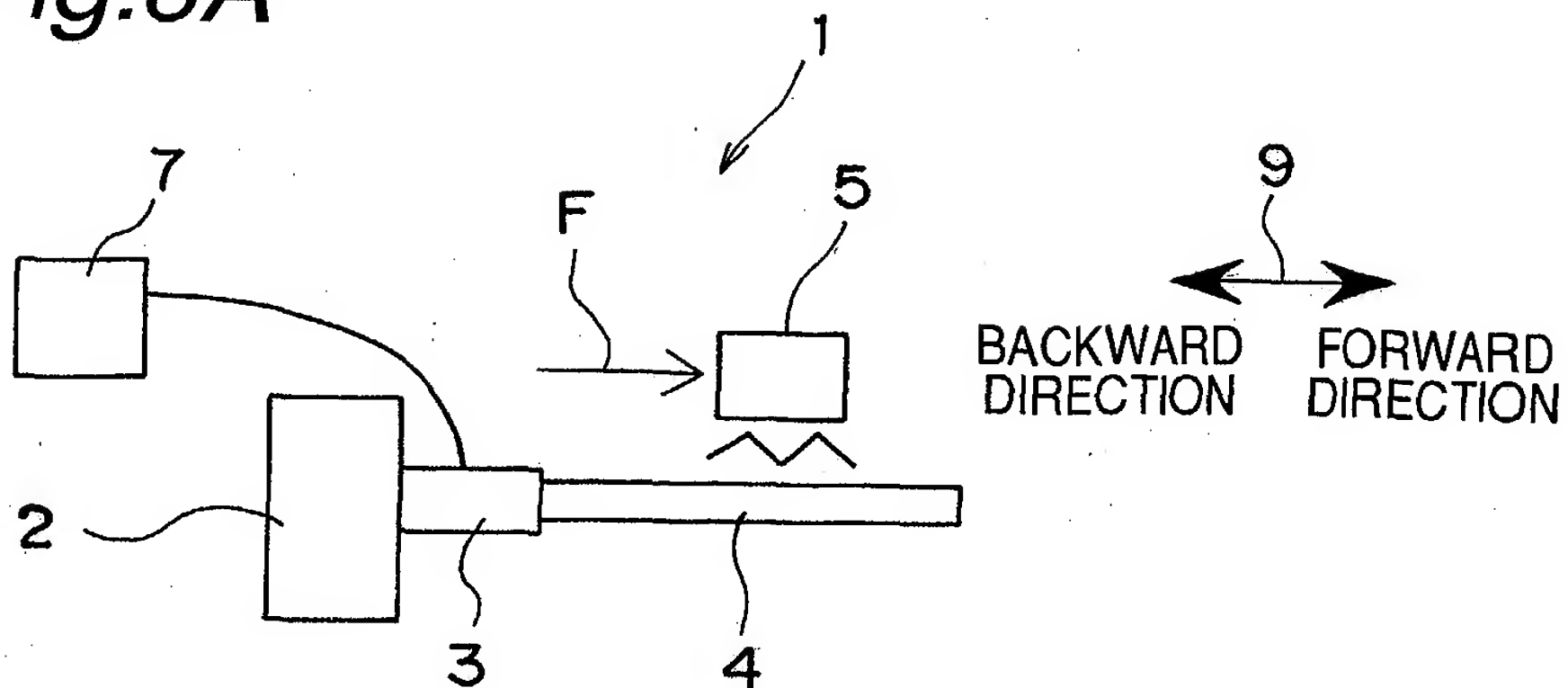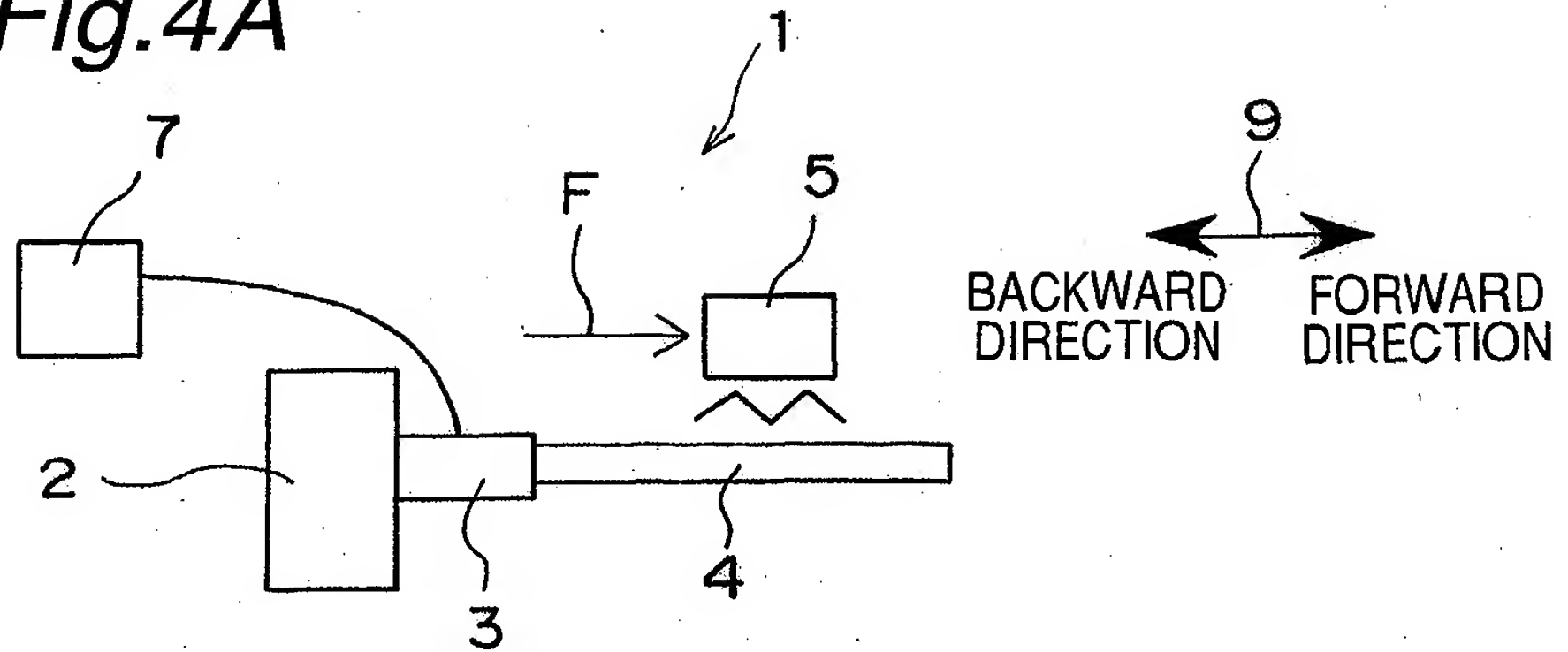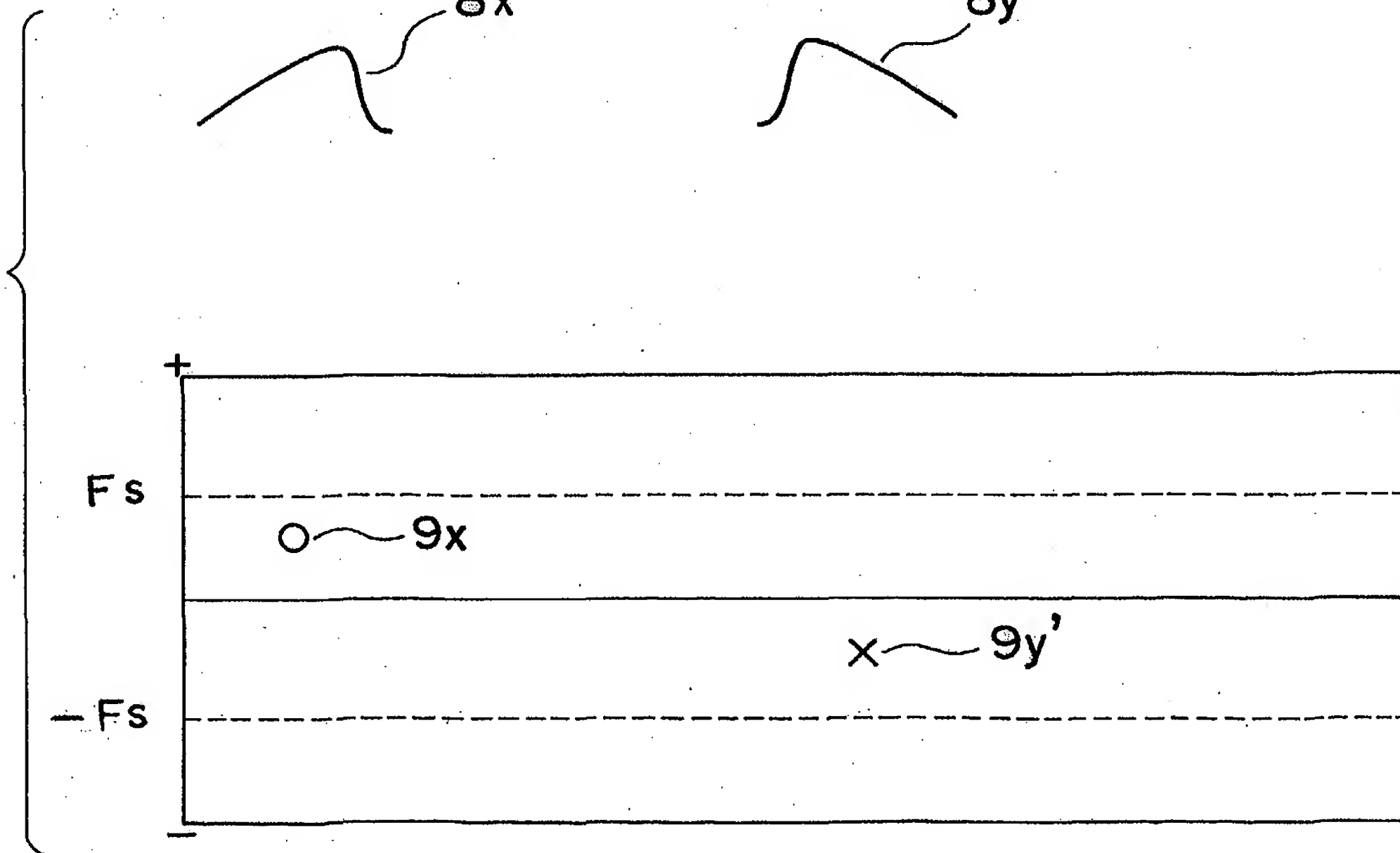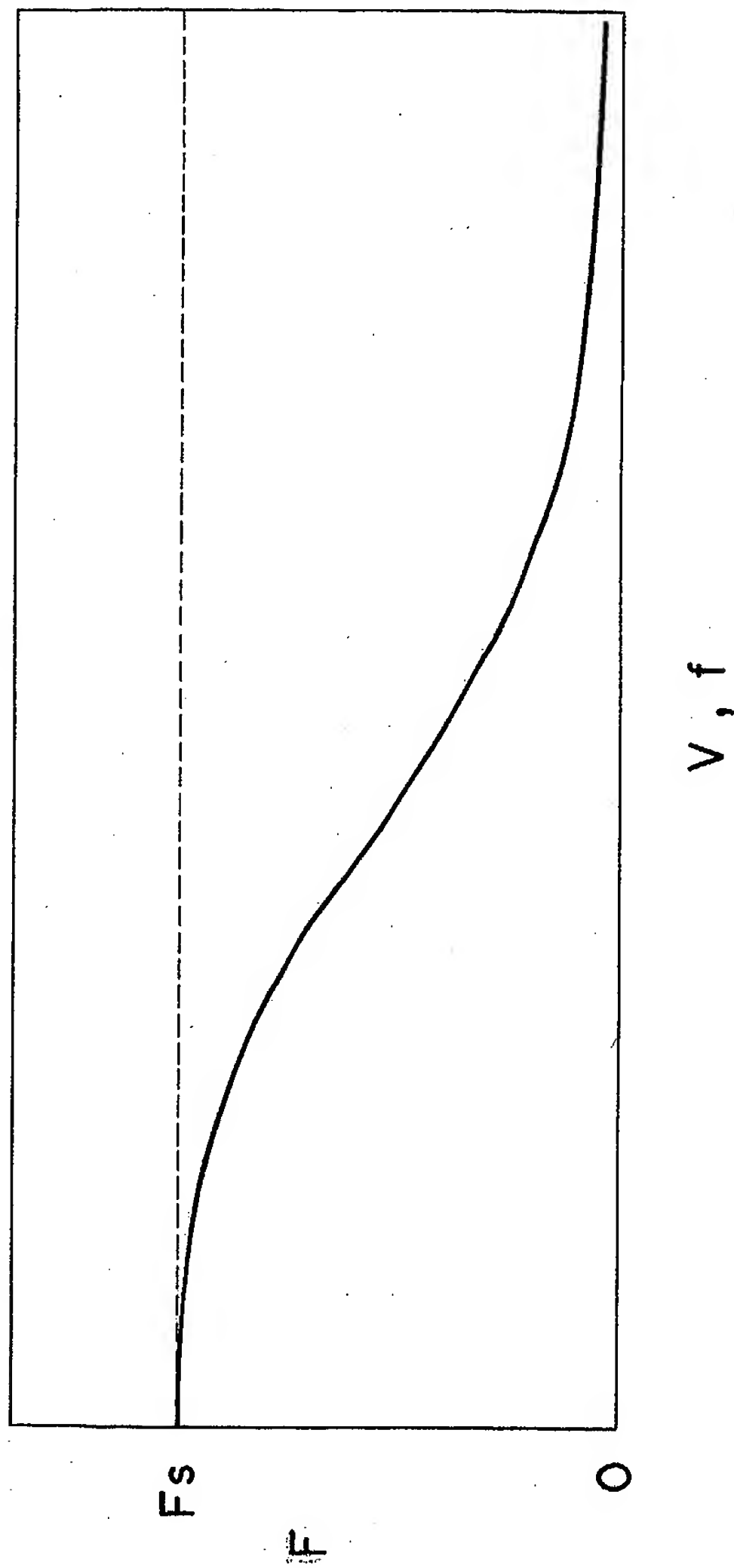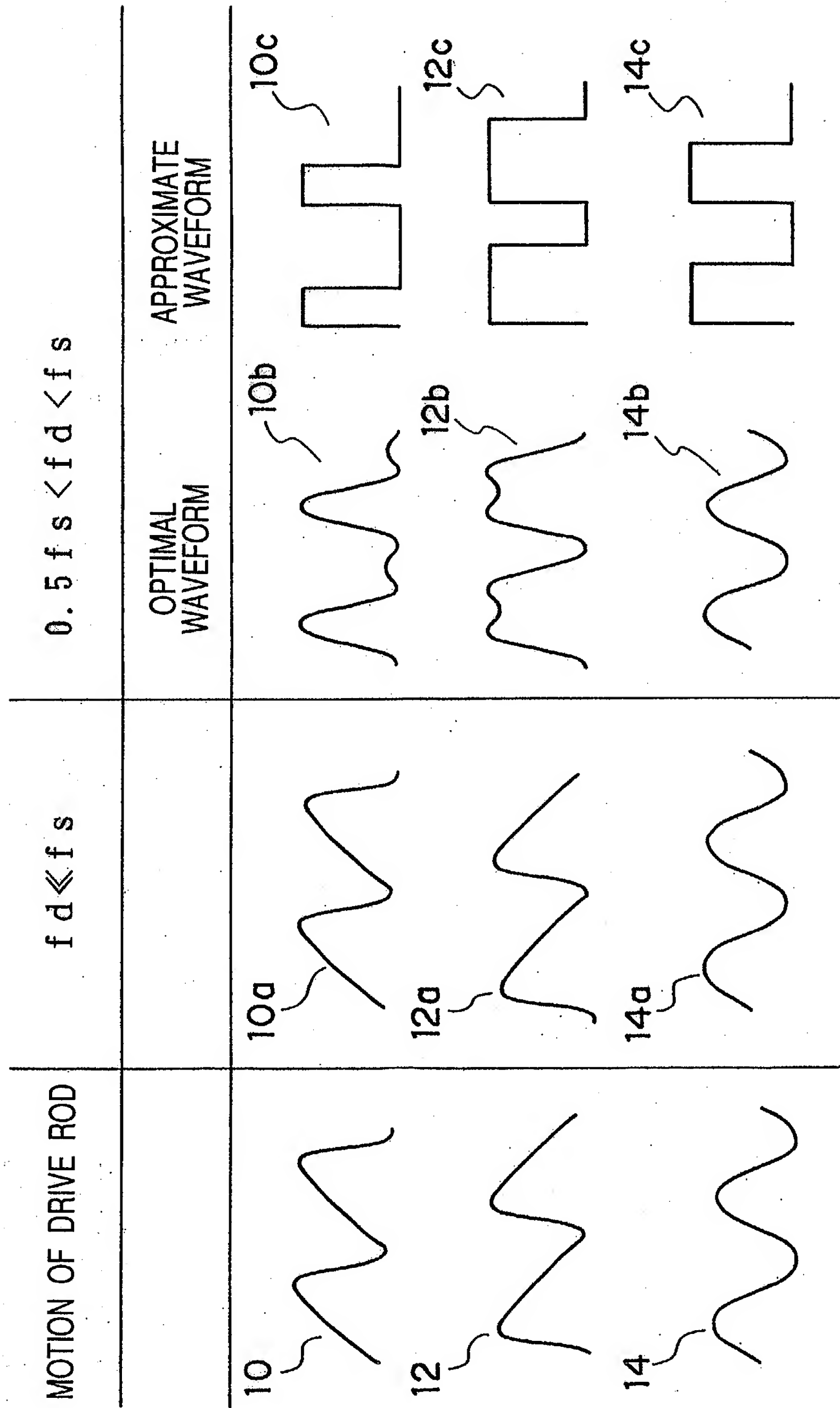
Fig.7A

VELOCITY OF
MOVING BODY

0.15   0.3   0.45   0.55   0.7   0.85

Fig.7B

EFFECT OF REDUCING
FRICTIONAL FORCE

0   1

Fig.8A

d = 0

Fig.8B

d = 0.1

Fig.8C

d = 0.3

Fig.8D

d = 0.5

Fig.8E

d = 0.7

Fig.8F

d = 0.9

Fig.8G

d = 1

Fig.9A

d=0.1   d=0.9   d=0.1   d=0.9

Fig.9B

d=0.3   d=0.7   d=0.3   d=0.7
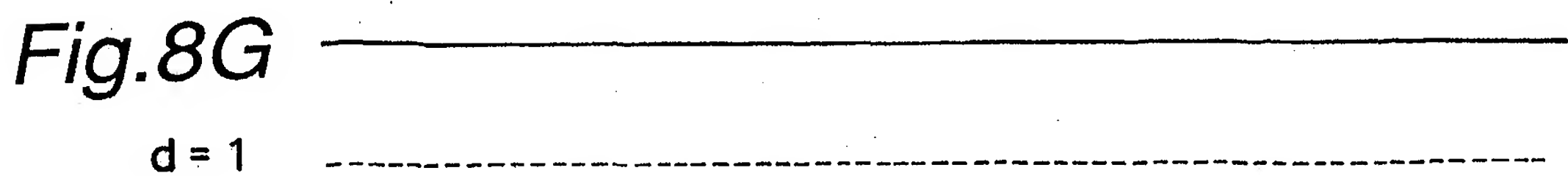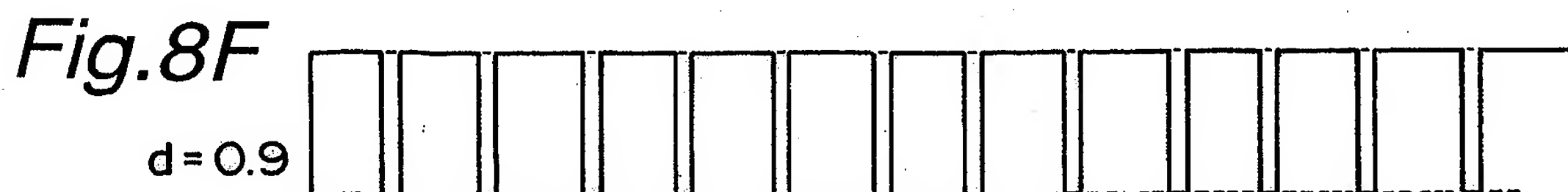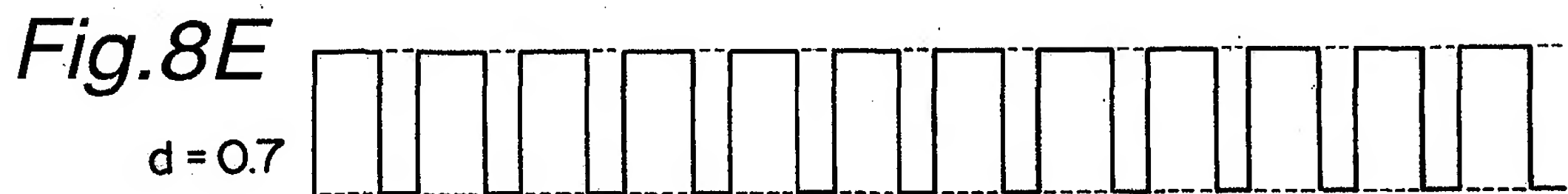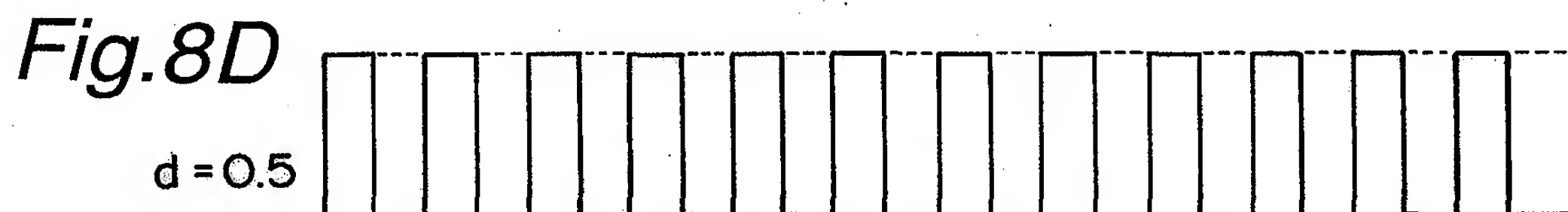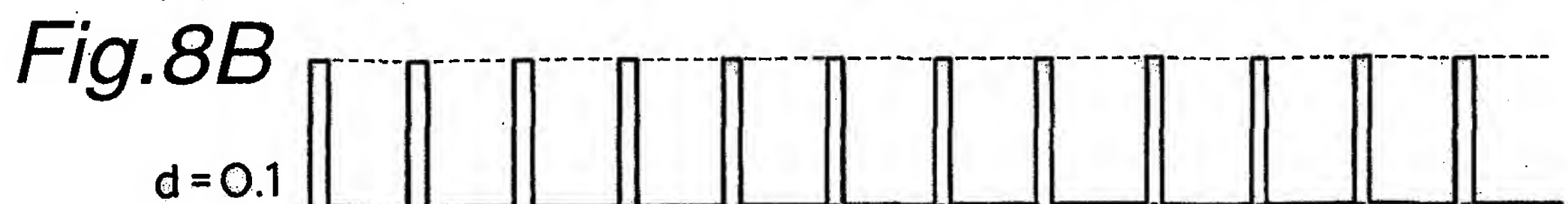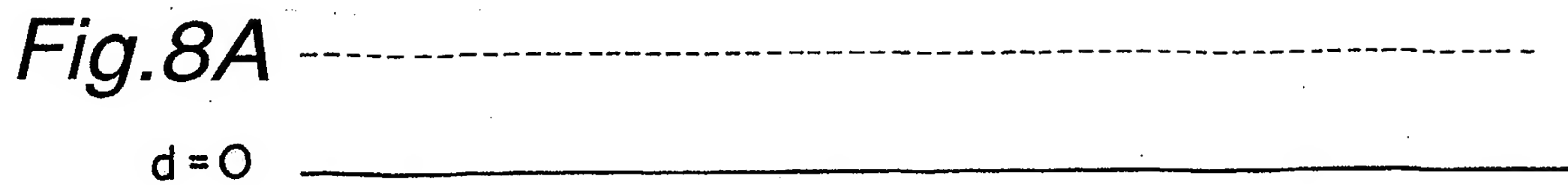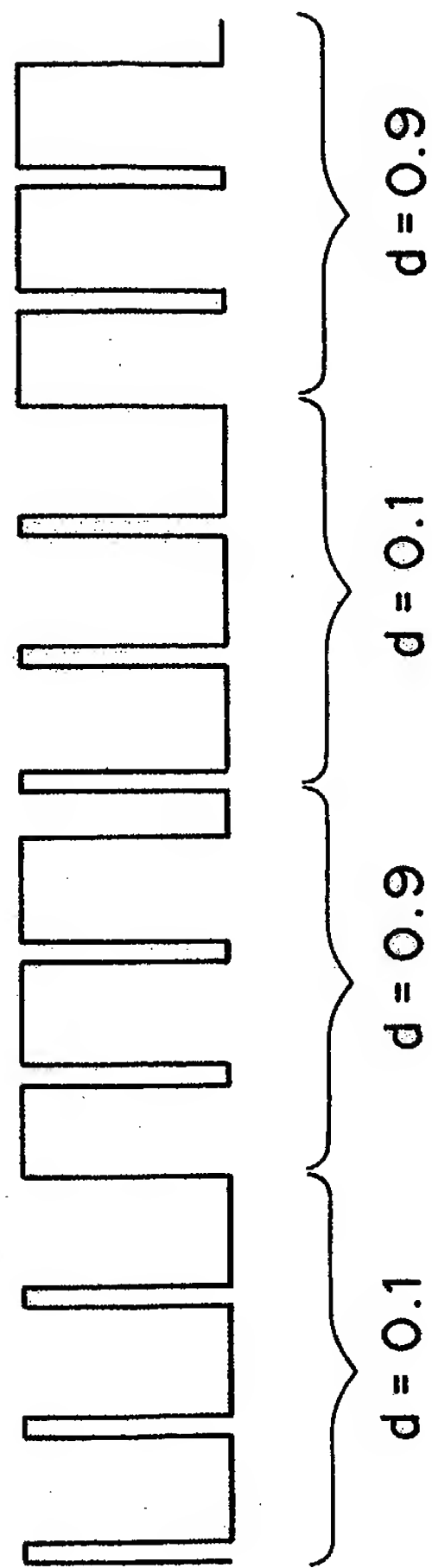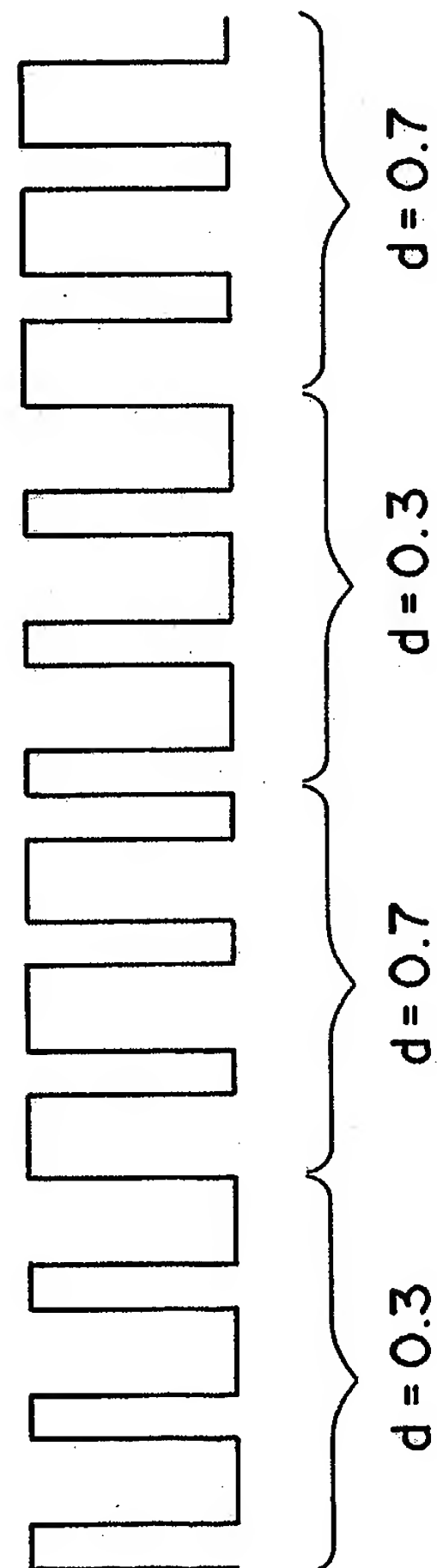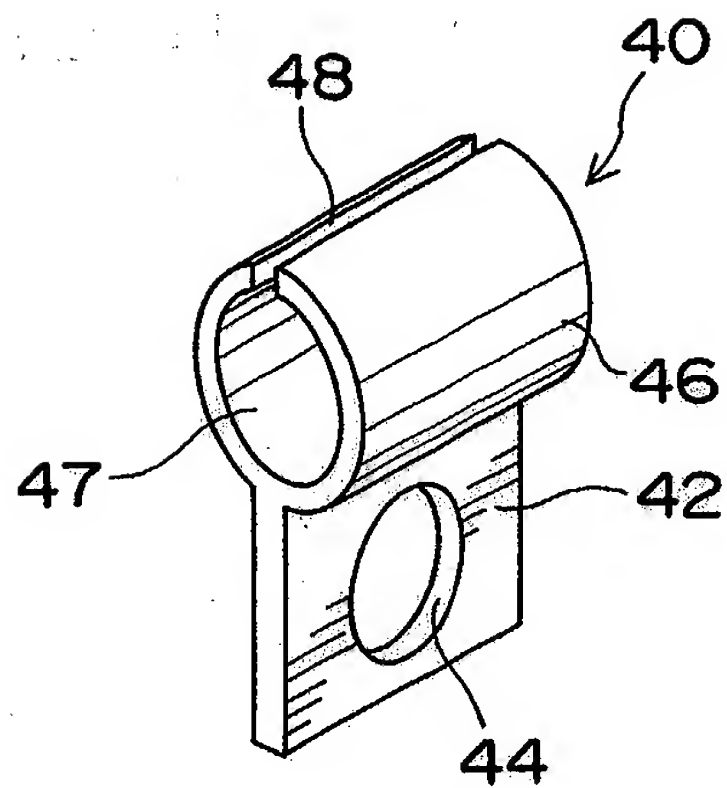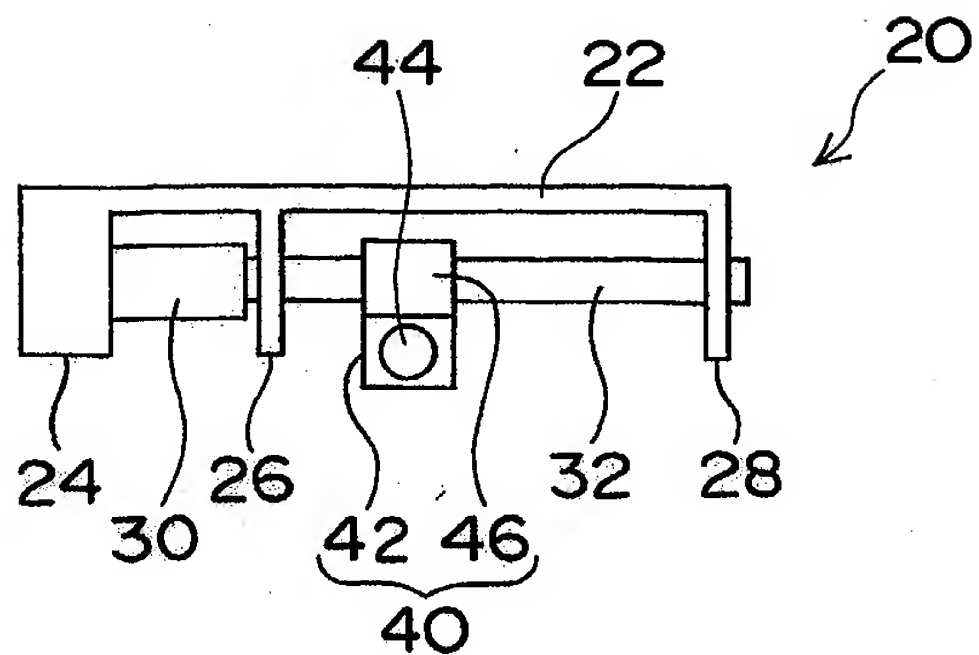
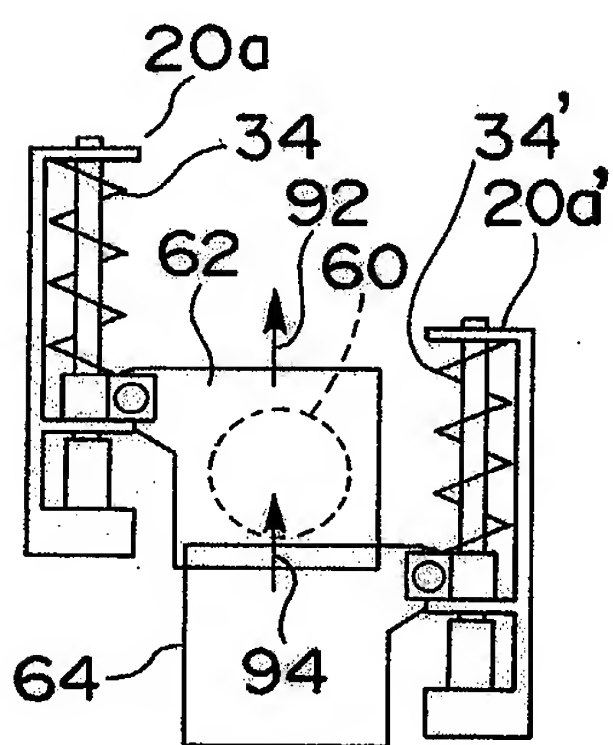*Fig.10A*
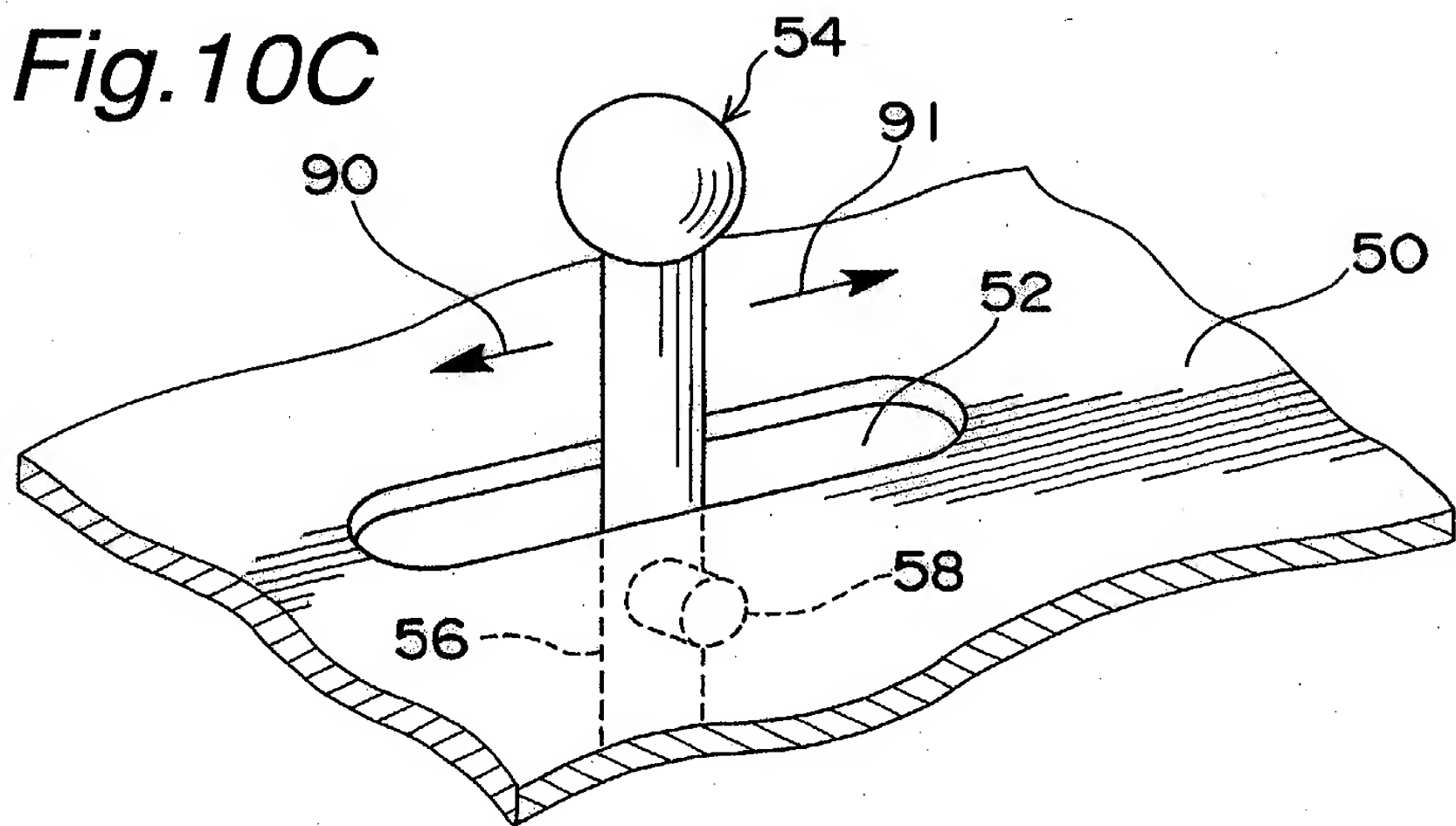
Fig.10B

Fig.10C

Fig.10D
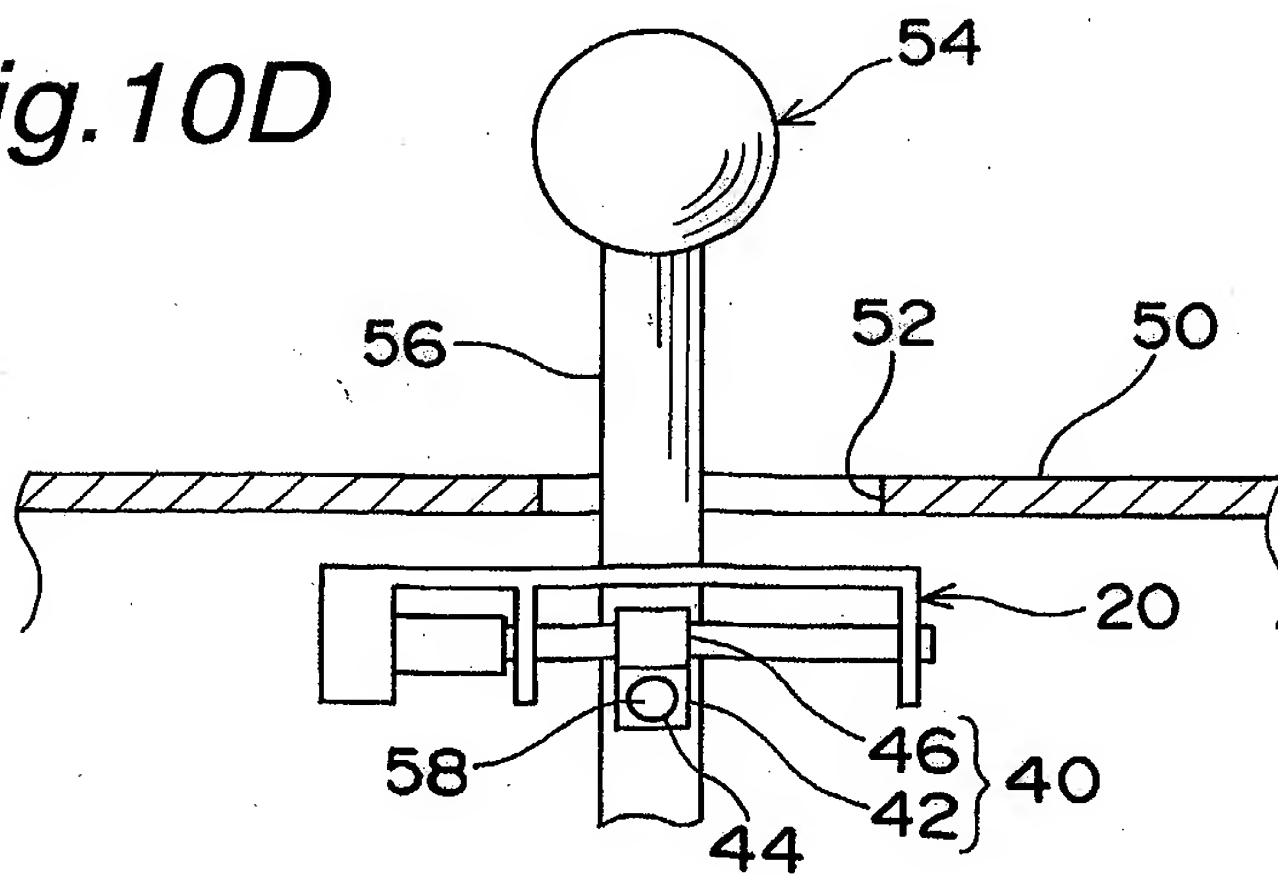
Fig.11A
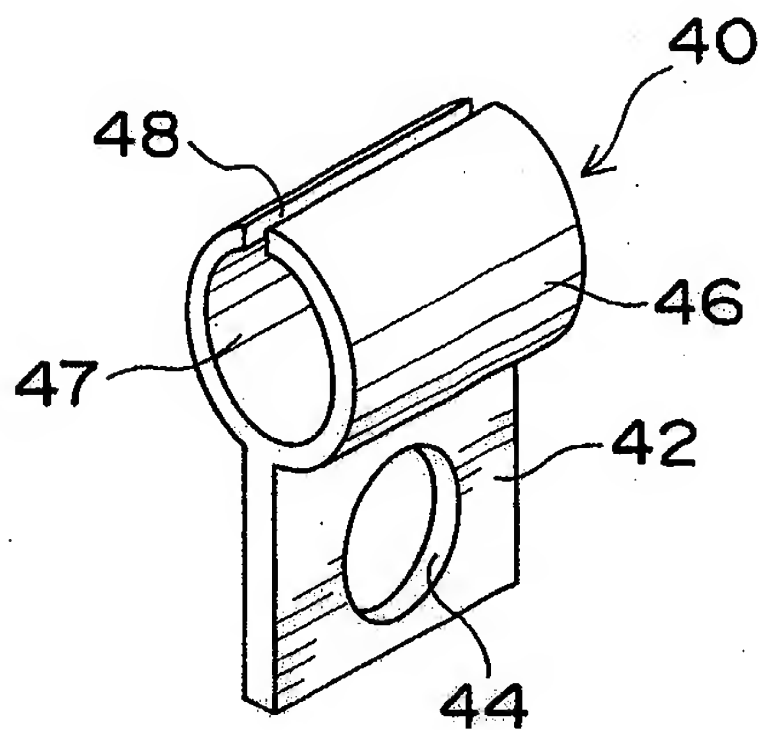
Fig.11B
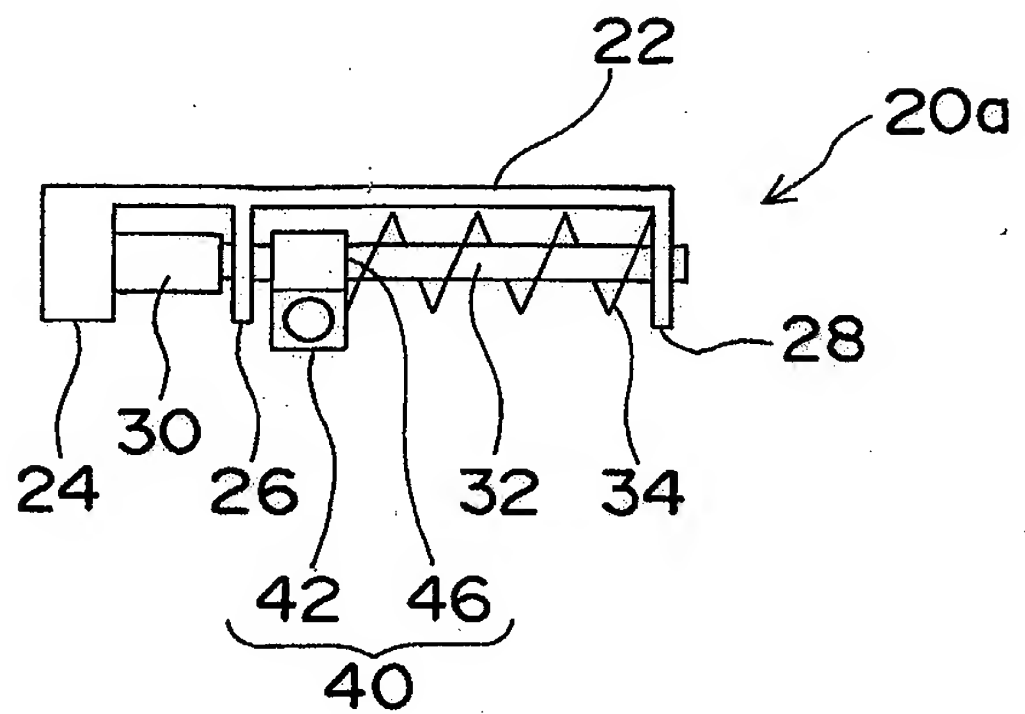
Fig.11C

Fig.11D
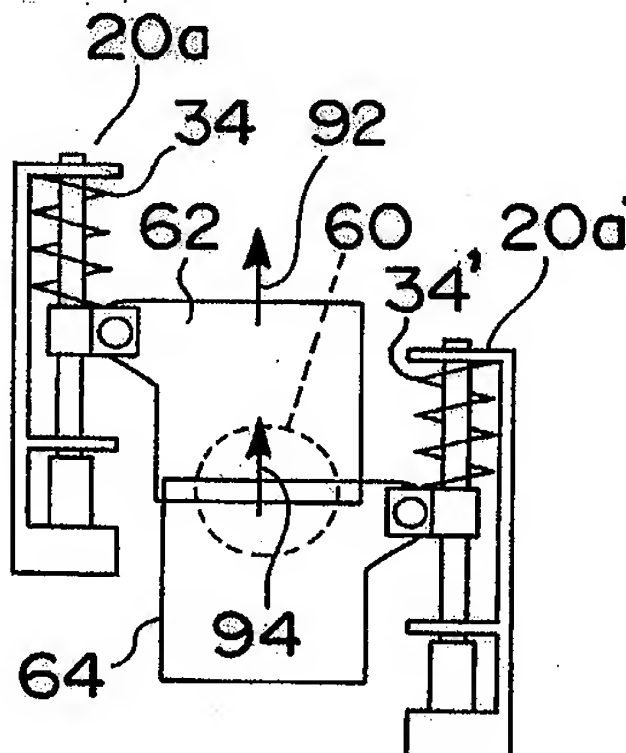
Fig.11E

Fig.11F

Fig.11G

Fig.11H